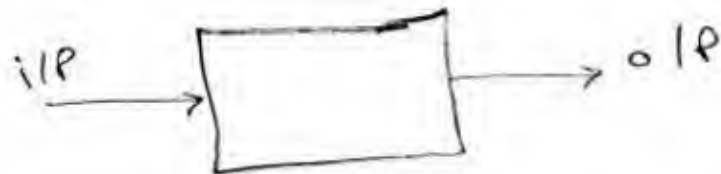


# classifcat (classification of systems)

## II no. of I/Ps and o/Ps

a) SISO



b) SIMO



c) MISO

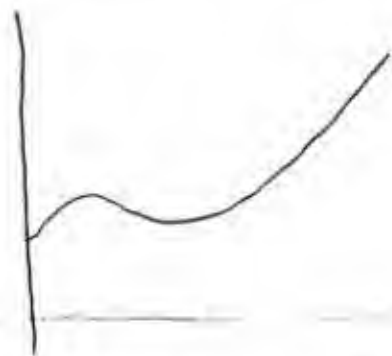


d) MIMO



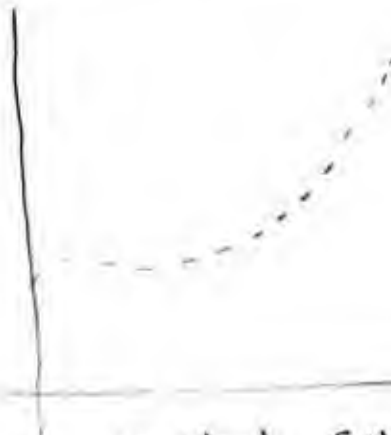
## [2] Continuously of signal

a) Cont.-time system



≡ Analogue system

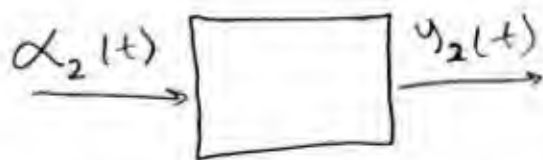
b) discrete-time sys.



≡ digital sys.

## [3] Linearity Property:-

a) Linear sys.



b) non-Linear sys

if

$$y(t) = y_1(t) + y_2(t)$$

→ Linear sys.

if not

if not

→ non Linear

#### [4] Physical Comp.

electrical      Mechanical      electro Mech      Fluid

→ The system can be in the form of:-

- Physical model
- Block diagram or signal flow graph
- State-space eqn.
- System eqns.
- Transfer Function

#### System Response

→ o/p in time domain

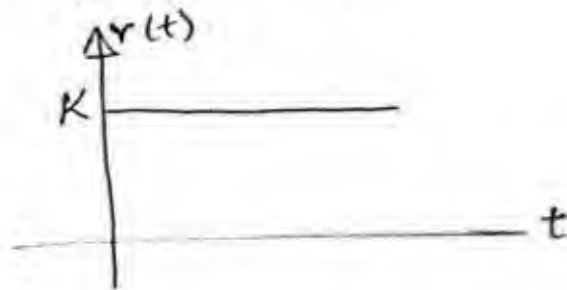


$$T.F = \frac{Y(s)}{R(s)} \Rightarrow Y(s) = [T.F] R(s)$$

$$\mathcal{L}^{-1}[Y(s)] = \mathcal{L}^{-1}[T.F * R(s)]$$

→ according to the iLP

① step response  $(r(t) = K)$

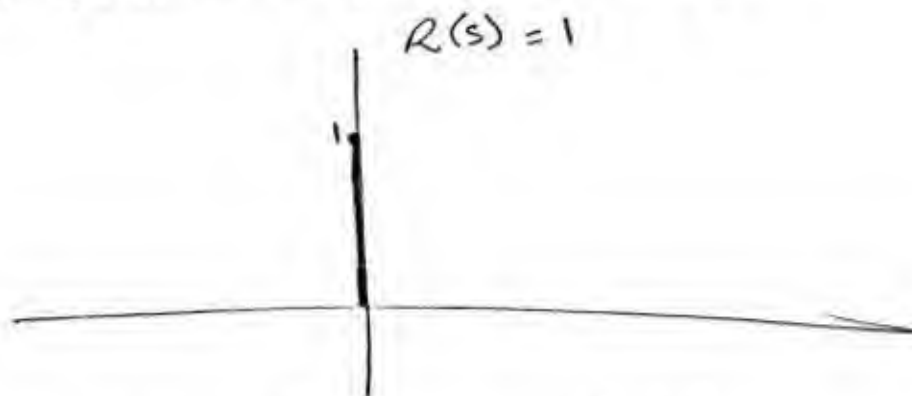


② Ramp Response  $(r(t) = Kt)$



③ Parabolic iLP  $(r(t) = Kt^2)$

④ impulse response  $(r(t) = \delta(t))$



$$r(t) = \delta(t) = \begin{cases} 1 & t = 0 \\ 0 & \text{otherwise} \end{cases}$$

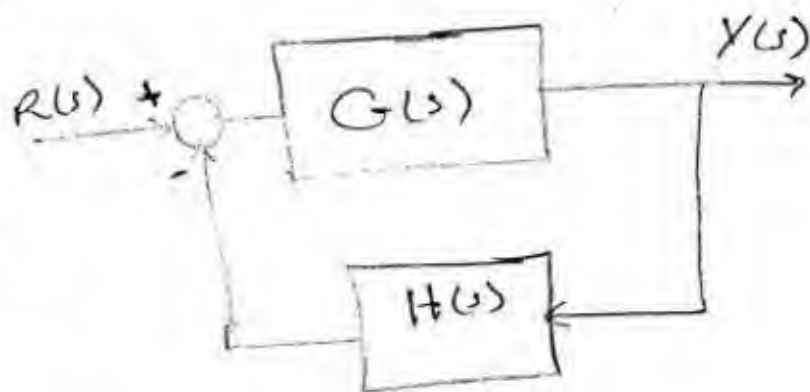
stability:

~~not~~

stable  $\Rightarrow$  For bounded i/p, there exist bounded o/p

Feedback system

$$T.F = \frac{G(s)}{1 + G(s) \cdot H(s)}$$



\* Closed-loop T.F = C.L.T.F = T.F

\* open loop T.F = O-L.T.F =  $G(s) \cdot H(s)$

\* ch. equation  $\Rightarrow 1 + G \cdot H(s) = 0$

\* Poles  $\Rightarrow$  The roots of ch/eqn.

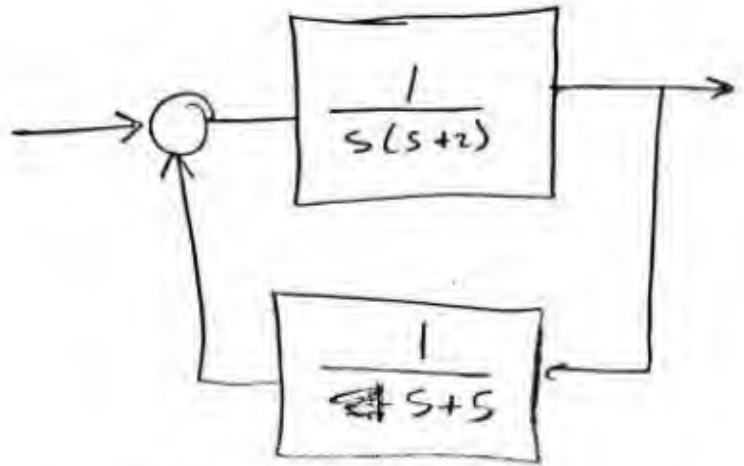
\* zeroes  $\Rightarrow$  The values of  $s$  that makes  $G(s) = 0$

\* System type  $\Rightarrow$  O.L.T.F

Ex

$$= \frac{1}{s(s+2)(s+5)}$$

type = 1

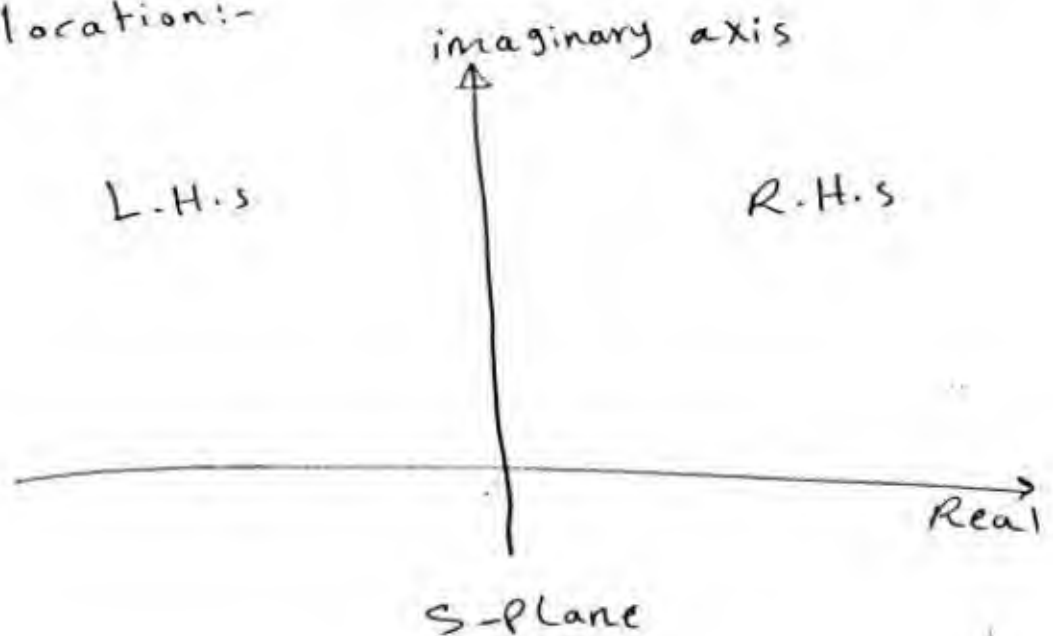


\* system order or system degree:-

$$\frac{1}{s(s+2)(s+5)}$$

$\Rightarrow$  3rd order

$\rightarrow$  To check the system stability using the Poles location:-



ليه لما احتاج دختير ال (stability) تعامل مع (Poles) وليس ال (Zeroes)

ex

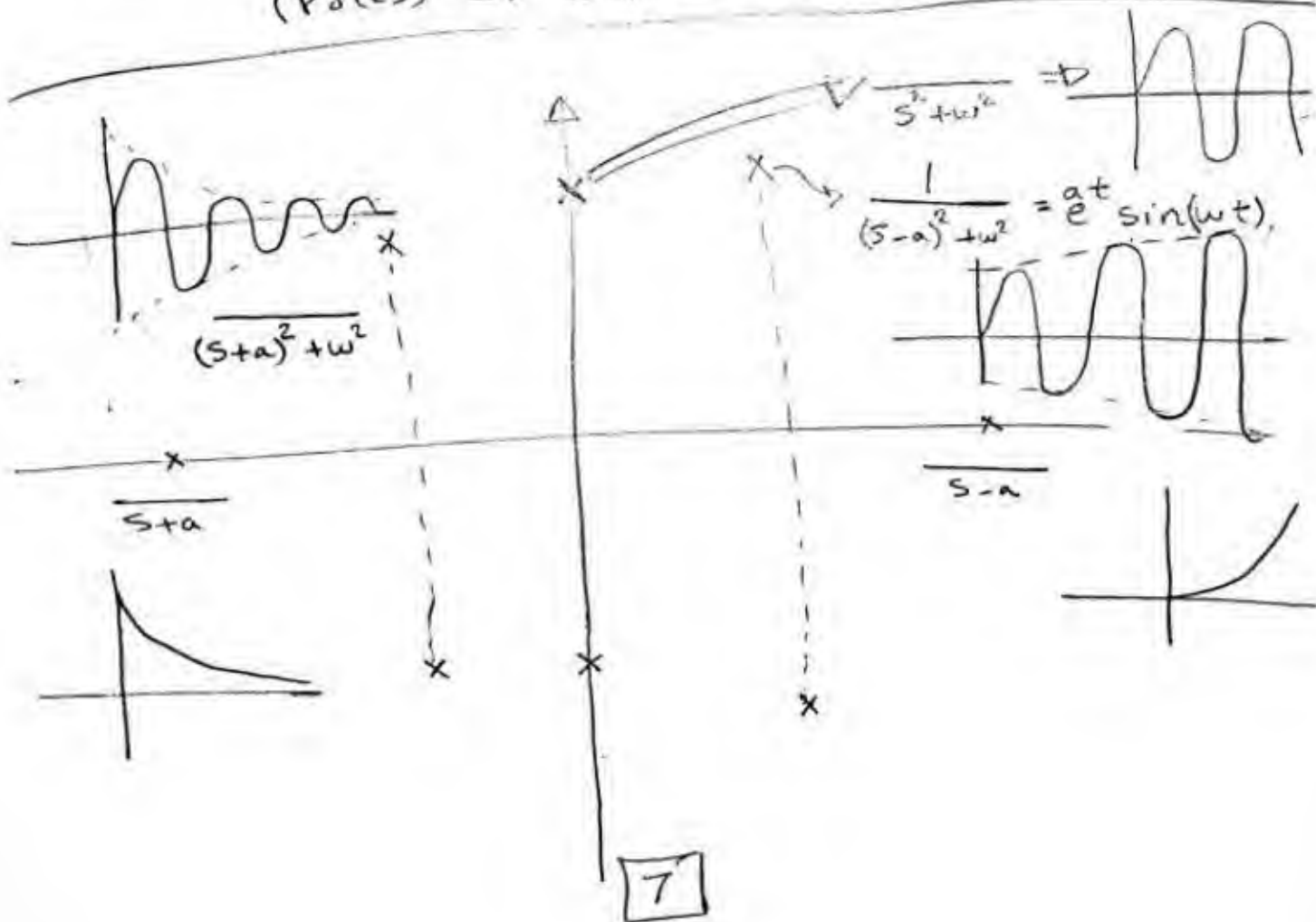
$$T.F = \frac{s+2}{(s+3)(s+5)}$$

$$R(s)=1$$

$$X(s) = \frac{s+2}{(s+3)(s+5)} = \frac{A_1}{s+3} + \frac{A_2}{s+5}$$

$$y(t) = A_1 e^{-3t} + A_2 e^{-5t}$$

هنا ال (Zeroes) اعملك رقم بيكر او ديون ~~ال~~ الرسم الناتج بس لسه التأثير يكون بسبب ال (Poles)



→ To check the system stability

\* Algebraic

- Routh method.

graphical method

- Root locus

- Bode diagram

- Polar Plot.

→ another classification:-

① ~~Relative~~ Absolute stability

- Routh Array  $\left\{ \begin{array}{l} \rightarrow \text{stable} \\ \rightarrow \text{unstable} \\ \rightarrow \text{critically stable} \end{array} \right.$

② Relative stability :-

$\left\{ \begin{array}{l} \rightarrow \text{Bode diagram} \\ \rightarrow \text{Polar Plot} \end{array} \right.$

→ يجعله أكثر مدى ال (Stability) للنظام

more stable or .....